

VAT-60

OPERATING INSTRUCTIONS

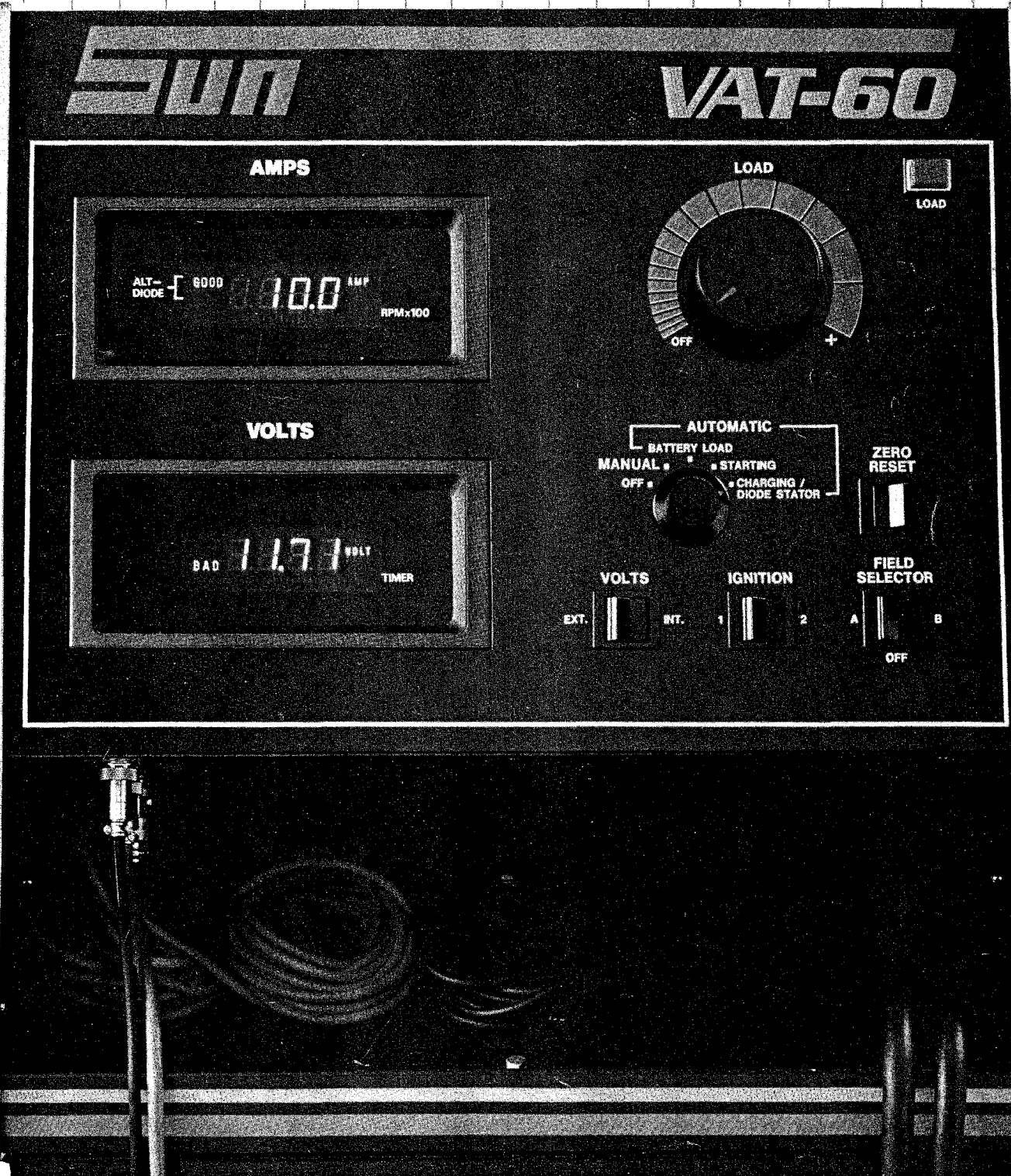


TABLE OF CONTENTS

SAFETY PRECAUTIONS	i	1. AUTOMATIC CAPTURE MODE	5
GENERAL INFORMATION	1	BATTERY LOAD	5
Description of Tester Functions	1	Pre-Test Condition	5
Tester Supply Voltage	1	Battery Load Test	5
DISPLAYS AND CONTROLS	1	STARTING	7
Vacuum Fluorescent Display	1	Starting System Area Test	7
Load Control Knob	1	CHARGING/DIODE STATOR	8
Load Indicator	1	Charging System Test	8
Function Selector	1	Charging/Diode Stator Tests	8
Zero/Reset Switch	2	2. MANUAL	10
Field Selector	2	General Test Capabilities	10
Ignition Selector	2	PINPOINT TESTING	10
Int/Ext Volt Selector	2	Starting System Pinpoint Tests	10
INPUTS AND LEADS	2	Insulated Circuit Resistance Test	10
Battery Load Leads	2	Ground Circuit Resistance Test	11
External Volt Leads	2	Switch Circuit Resistance Test	12
Clamp-on Amp Probe	3	Charging System Pinpoint Tests	13
Blue Field Leads	3	Output Test Using Tester Field Selector	13
Trigger Lead or Inductive Tach Probe	3	Charging System Requirements Test	13
TESTER FUNCTIONS/FEATURES	3	DC Charging System Test	13
Alarm Function	3	Circuit Resistance Test	14
"Freeze" Function	3	Insulated Circuit Resistance Test	15
"Flashing" Function	3	Ground Circuit Resistance Test	15
"Test Complete" Beeper	3	Regulator Ground Circuit Resistance Test	16
Test Aborted Condition	3	12 VOLT CHARGING — 24 VOLT STARTING	
Integral Fan	4	TESTING PROCEDURES	16
PRELIMINARY INSPECTION	4	Preparation and Hookup	16
HOOKUPS AND TESTING PROCEDURES	4	Starter System Tests	17
Calibration	4	Charging System Tests	17
TESTING MODES	5	COMPONENTS AND ACCESSORIES	18

SAFETY PRECAUTIONS

Listed below are SOME of the safety precautions which must be observed while using the VAT 60 Volt/Amp tester. FAILURE TO OBSERVE ANY OF THESE PRECAUTIONS, OR OTHER UNSAFE USE, MAY RESULT IN PROPERTY DAMAGE AND/OR SERIOUS PERSONAL INJURY. NEVER allow improperly trained personnel to operate this equipment. Carefully read these operating instructions.

VENTILATION

Provide adequate ventilation thru an exhaust gas removal system, adequate ventilation fans, or large open doors. All engines suitable for testing with this tester emit carbon monoxide gas. A person breathing this odorless gas will suffer slowed reactions, which may lead to personal injury.

MAKE SURE THAT THE VEHICLE CANNOT MOVE DURING TESTING.

- Automatic transmission shift lever in PARK position.
- Manual transmission shift lever in NEUTRAL position.
- PARKING or EMERGENCY BRAKE securely set.
- If there is any doubt, BLOCK THE WHEELS.

ALSO, BE CERTAIN that the hood support rod is engaged in the proper socket, or that the spring assisted hood lift is fully capable of supporting the open hood.

UNIT STABILIZATION

- The VAT 60 should be properly secured to its stand to avoid slippage accidents and to assure optimum test results.
- Brake casters on front wheels provide added stability.

TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THE TESTER TO RAIN OR MOISTURE.

BEFORE CONNECTING OR DISCONNECTING BATTERY LOAD LEADS (FIGURE 1), LOAD CONTROL KNOB SHOULD BE TURNED FULLY COUNTER-CLOCKWISE (OFF) AND FUNCTION SELECTOR **MUST BE IN "OFF" POSITION TO PREVENT SPARKING.**

CONNECTING OR DISCONNECTING BATTERY LOAD LEADS WITHOUT LOAD CONTROL KNOB AND FUNCTION SELECTOR IN OFF POSITION CAN RESULT IN POSSIBLE EXPLOSION OF BATTERY.

VEHICLE BATTERIES

Vehicle batteries contain sulfuric acid and produce explosive gases. To avoid battery explosion and serious personal injury, follow these important safety precautions whenever servicing batteries:

- Put on safety goggles before doing any work on batteries.
- Keep lighted cigarettes, sparks, flames, and other ignitable sources away from battery at all times.
- Avoid contact with metal objects, such as tools, that could cause sparks.
- Do not wear metal jewelry, rings, or watches when working on or around batteries.
- Never lean over battery during testing.
- Cover vents on top of battery with damp cloth to suppress explosive gases.
- Have a supply of water handy, should it become necessary to flush away spilled battery acid.
- Be very careful when working under the hood to check the fan blades, belts, pulleys, etc., and keep out of direct line with the blades.

AVOID bringing hook-up leads over engine fan and accessory belt drive areas. Whenever possible, route leads outside of the engine compartment and away from hot surfaces.

AVOID wearing loose clothing when working on running engines.

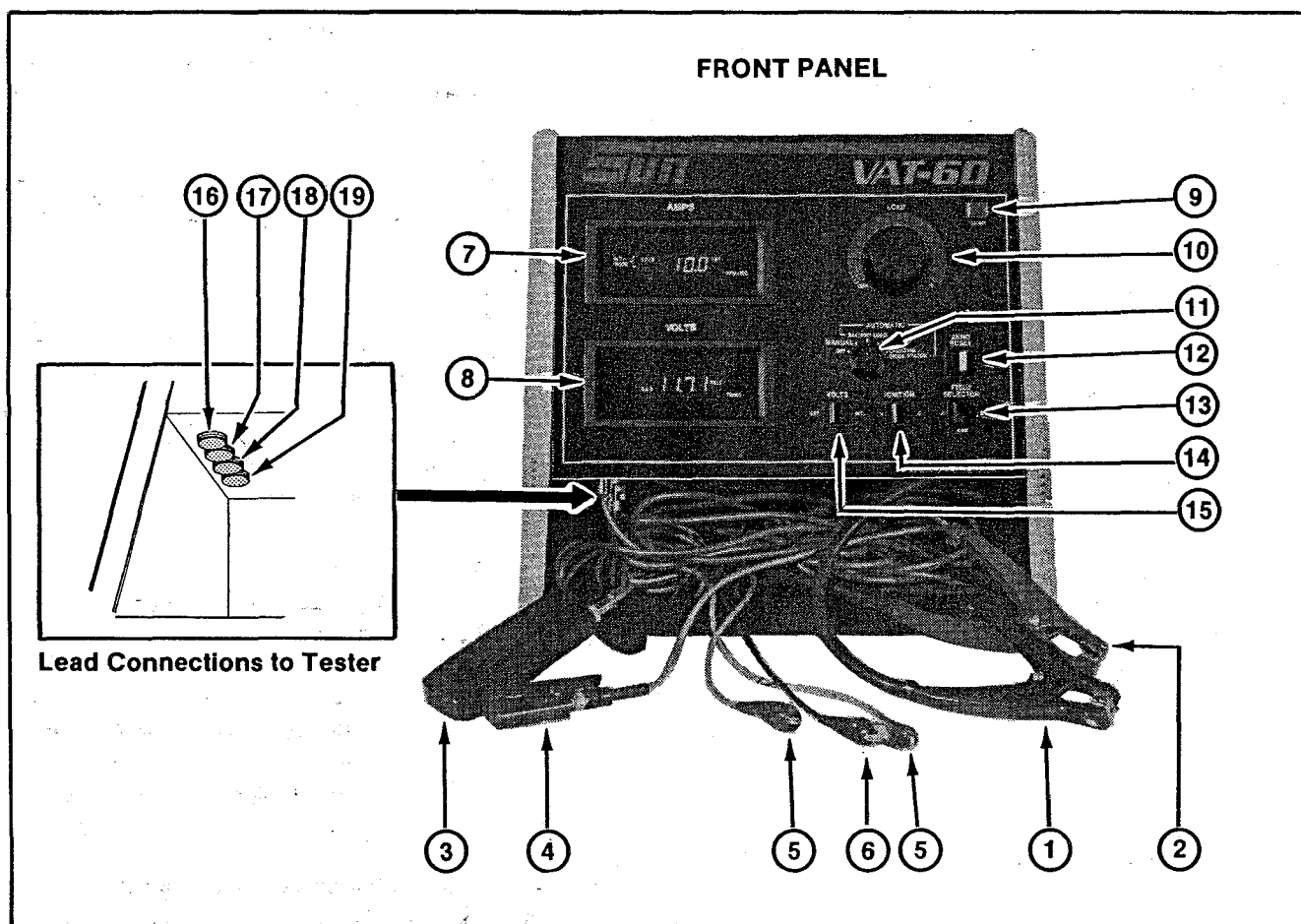


FIGURE 1. VAT-60 Volt Amps Tester Diagram

Vehicle Connections

- 1 — Neg. battery clip (black)
- 2 — Pos. battery clip (red)
- 3 — Amp probe (black)
- 4 — Trigger lead or inductive tach probe (red)
- 5 — External volt leads
- 6 — Field leads (blue)

Displays

- 7 — Amps
- 8 — Volts

Controls

- 9 — Load indicator
- 10 — Load control knob
- 11 — Function selector
- 12 — Zero/reset switch
- 13 — Field selector
- 14 — Ignition selector
- 15 — Int/Ext volt selector

Lead Connections to Tester

- 16 — Trigger lead input (for rpm)
- 17 — Amp probe input
- 18 — Ext volt leads input
- 19 — Blue field lead input

GENERAL INFORMATION

DESCRIPTION OF TESTER FUNCTIONS

The VAT 60 diagnostic Volts/Amps Tester provides automated test sequences for battery, starting, and charging systems. The microprocessor-controlled computer simplifies test procedures on these systems and indicates results digitally on special vacuum fluorescent displays (VFD's). Amps, volts, rpm, and time in seconds can be displayed on the VFD's. Additionally, GOOD/BAD indicator displays results of tests based on pre-determined limits.

Unit also includes an automatic zero adjust/reset switch, function selector, load control knob and lamp, internal/external volt selector, field selector, and ignition selector. Also, an alarm and fan indicate and cool carbon pile overheat conditions.

Function selection and lead connections are performed by the operator.

Recessed lead storage area on front of tester. Tester includes portable test stand.

TESTER VOLTAGE SUPPLY

The VAT 60 is powered from the vehicle battery via the battery load leads. The accuracy of the amps display readings is maintained as long as the voltage available to the load leads is 4.5 volts or more. Should the applied voltage fall below 4.5 volts, the amps display will blank out.

DISPLAYS AND CONTROLS

VACUUM FLUORESCENT DISPLAY (VFD)

Two dual-function VFD's digitally display values in large 14 cm numerals. VFD values can freeze or flash in certain conditions described later in this manual under TESTER FUNCTIONS/FEATURES. Each display measures 6-1/2 x 2-3/4 inches. (See Figure 1.)

Amps/rpm

Amps display indicates current (amps) on tests and includes an rpm tachometer that shows rpm from 0 — 3000 in 100 rpm lighted increments or "pickets". RPM will be displayed when the FUNCTION SELECTOR is in the MANUAL and CHARGING positions. Readings over 3000 rpm will cause all display pickets to flash until the value falls below this maximum limit. Amps display also gives GOOD/BAD condition of diode stator following that system test.

Volts/Time

Volts display indicates volts and also includes a 15

second countdown timer divided into 1/2 second illuminated pickets that go out as testing time expires. Beeper automatically sounds when 15-second test time expires.

NOTE: The operator does not need to see the displays during testing. Test results will be stored after beeper sounds.

Good/Bad Indicator

Both displays are equipped with a GOOD/BAD indicator to display results of system tests based on pre-determined limits for that specific test. The indicator(s) will remain displayed until the test is reset or the FUNCTION SELECTOR has been placed in the MANUAL or OFF position.

LOAD CONTROL KNOB

The LOAD CONTROL KNOB (Figure 1) is used to load 6 or 12 volt batteries. Loads up to 600 amperes at 11V or 6.6Kw can be applied with a duty cycle of 15 seconds "LOAD ON" followed by a 60-second "LOAD OFF" to be observed. The LOAD CONTROL KNOB is also used to apply manufacturer's specified loads in performing charging system tests and detailed tests.

NOTE: Loads should only be applied to 6 or 12-volt batteries.

LOAD INDICATOR

When the LOAD INDICATOR light (Figure 1) is ON, it indicates a load is being applied. When the LOAD CONTROL KNOB is OFF, the LOAD INDICATOR will be OFF as well, indicating a "no load" condition.

CAUTION: The LOAD INDICATOR is a reminder to set the LOAD CONTROL KNOB "OFF" after completion of a test requiring a load. A periodic check of the LOAD INDICATOR light bulb is strongly recommended.

FUNCTION SELECTOR

The FUNCTION SELECTOR (Figure 1) allows the operator to move easily from one system test to another. The selector is comprised of an OFF position, one MANUAL testing mode, and three AUTOMATIC CAPTURE testing modes: BATTERY LOAD, STARTING, and CHARGING/DIODE STATOR.

Basically, each mode's general function is as follows:

OFF — OFF is not a mode of operation. It is designed as a safety feature to shut power off to the unit.

CAUTION: Though FUNCTION SELECTOR may be in OFF position and no power is enter-

ing the VAT 60, a load generated by the **LOAD CONTROL KNOB** can still be applied to a 6 or 12-volt battery.

CAUTION: LOAD CONTROL must show OFF when connecting leads.

MANUAL — The **MANUAL** mode allows the operator to make voltage (external and internal), amps, and rpm readings without a **GOOD/BAD** determination. The **15 SEC TIMER** can be utilized in the **MANUAL** mode.

BATTERY LOAD — The **BATTERY LOAD** test allows the operator to conduct an automated test sequence determining the **GOOD/BAD** state of a vehicle battery. The **BATTERY LOAD** test is administered after a pre-test battery condition evaluation.

STARTING — This mode allows for voltage and current readings to be displayed while the engine is cranking.

CHARGING/DIODE STATOR — This mode enables a test on the diode/stator and charging system. Volts, amps, and rpm values are displayed as is the **GOOD/BAD** status of the diode/stator.

NOTE: It is not necessary to perform tests in the specific FUNCTION SELECTOR order. The VAT 60 is designed so that any system test can be performed in any desired testing order.

Each mode is discussed in greater detail in the **TESTING MODES** section of this manual.

ZERO/RESET SWITCH

This spring-loaded rocker switch (Figure 1) is used to automatically clear displays and set **BLACK AMP PROBE** at 0.

When adjusting zero, the **FUNCTION SELECTOR** must be in the **MANUAL** mode with the load leads connected to the battery. Additionally, the jaw of the **AMP PROBE** must be closed and no current flow must be present.

FIELD SELECTOR

This three-position rocker switch (Figure 1) is used in conjunction with the **BLUE FIELD LEAD**. It has a spring-loaded "off" position. Its left and right positions are identified "A" and "B" respectively.

In the "A" position — The **BLUE LEAD** is internally connected to the negative battery cable for testing A circuits.

In the "B" position — The **BLUE LEAD** is internally

connected to the positive battery cable for testing B circuits.

IGNITION SELECTOR

The two-position **IGNITION SELECTOR** switch (Figure 1) enables RPM measurements for 4-cycle (position 1) and 2-cycle (position 2) engines. Position two also accommodates tests for other ignition systems (ie., C³I (wasted spark) and rotary engines).

INT/EXT VOLT SELECTOR

The **VOLT SELECTOR** (Figure 1) is set in the **INT** position for most tests. In this position, the volts display is internally connected to the load cables and then to the battery through special wires within the load leads. This eliminates two test connections.

When the **VOLT SELECTOR** is set to the **EXT** position, the volts display is connected to the external red and black volt leads. The external red and black volt leads are connected to the VAT 60 through an input located beneath the unit's front panel (Figure 1). Inputs and leads are further discussed on the following pages.

NOTE: The input impedance of the leads is 10 megohms.

NOTE: To use the EXTERNAL VOLT LEADS the BATTERY LOAD LEADS must be connected to a battery.

INPUTS AND LEADS

The leads themselves and their respective inputs on the VAT 60 are best illustrated in Figure 1 and are discussed below.

BATTERY LOAD LEADS

The red and black **INTERNAL BATTERY LOAD LEADS** (Figure 1) serve three purposes:

1. To provide the power to operate the tester.
2. To load test a six- or twelve-volt battery.
3. To provide voltage readings when the **INT/EXT VOLT SELECTOR** is in the **INT** position.

The **BATTERY LOAD LEADS** are color-coded; red for positive and black for negative.

EXTERNAL VOLT LEADS

This pair of red and black volt leads (Figure 1) is used whenever voltage measurements other than battery terminal voltage are to be made. These leads are internally disconnected from the volts display

any time the INT/EXT VOLT SELECTOR is in the INT position.

CLAMP-ON AMP PROBE

The black CLAMP-ON AMP PROBE (Figure 1) is attached to the unit via a green test lead. The AMP PROBE senses the amount of current flowing in any wire.

NOTE: Polarity can be ignored when clamp is on **test lead** but must be observed when clamp is on **vehicle cable**.

To use the arrow on the probe to indicate proper polarity, clamp the black AMP PROBE around the negative battery cable with the arrow pointing **away** from the battery. When the AMP PROBE is on the plus (+) side, the battery is charging.

A special circuit in the tester uses the CLAMP-ON AMP PROBE to sense diode stator conditions, provided that at least 5 amps of current is flowing.

BLUE FIELD LEADS

The BLUE FIELD LEAD is used in place of the voltage regulator when it becomes necessary to bypass the regulator for making a pinpoint charging system output test. This lead is equipped with the three commonly used connector types for convenient connections to alternator and generator field terminals. See Figure 1.

CAUTION: Place boot over lead not in use to prevent field leads from grounding out.

TRIGGER LEAD or INDUCTIVE TACH PROBE:

The TRIGGER LEAD or INDUCTIVE TACH PROBE clamps around any spark plug wire for engine speed indication.

TESTER FUNCTIONS/FEATURES

ALARM FUNCTION

The purpose of the ALARM FUNCTION is to indicate that a condition exists which may cause damage to the unit, battery, or vehicle charging system. The alarm will function in any of the FUNCTION SELECTOR positions. Under the following conditions, a beeper will sound and either the amps or voltage displays will flash until the alarm condition is removed or tester (and load) is placed in OFF position. Resets will not operate.

1. When the internal voltage values are greater than 16 volts alarm will sound and voltage display will flash.

2. When the external voltage values are greater than 24 volts alarm will sound and voltage display will flash.
3. When the unit's carbon pile has reached an overheat condition alarm will sound and amps display will flash. Detection of this condition is achieved through the use of a thermo sensor/switch located near the carbon pile assembly.

"FREEZE" FUNCTION

The purpose of the "FREEZE" FUNCTION is to "freeze" the displayed voltage and current values of a test at a specified point in the test sequence. The readings will freeze automatically.

Displays remain FROZEN until:

1. Test is reset.
2. FUNCTION SELECTOR has been moved to OFF. (Test results lost.)

"FLASHING" FUNCTION

Display "FLASHES" when:

1. Volts or amps measurements are not within limits (open circuit voltage less than 12.4).
2. Questionable data exists based on failure of another test value to be within limits.
3. Test is considered incomplete.

Display "FLASH" stops when:

1. Test has been reset.
2. FUNCTION SELECTOR has been moved to MANUAL.

Any test results stored in a FLASHING mode will be redisplayed in this manner whenever the FUNCTION SELECTOR has been moved to a different selector position (other than MANUAL) and returned.

"TEST COMPLETE" BEEPER

Where stated, a beeper will sound twice at the end of a test sequence to indicate test completion.

TEST ABORTED CONDITION

An operator aborts a test by either voluntarily choosing to end a specific test before its regular finish or by making a mistake in a test procedure or hook-up.

The VAT 60 also aborts specific system tests when certain data readings do not meet the limits neces-

sary within a specific amount of time for testing to continue.

"Test Aborted" conditions:

Battery Load tests — amps reading falls below 50 before the 15-second TIMER has timed out.

Starting system tests — starter current drops below 50 amps after the test has begun.

Diode Stator/Charging system tests — 1.) current value is less than 10 amps once the test begins. 2.) engine rpm value falls below 2000 once test begins.

TEST ABORTED CONDITIONS are also discussed more in-depth in specific TESTING MODES sections of this manual.

INTEGRAL FAN

The INTEGRAL FAN is activated whenever the VAT 60's carbon pile assembly becomes too warm.

PRELIMINARY INSPECTION

Before any testing is done, a series of visual inspections should be performed. These inspections should include drive belts, charging system components, battery, and associated cables.

Belt Inspection

1. Inspect condition and tension of drive belts.
2. If necessary, replace and/or adjust to proper tension before proceeding with tests.

Charging System Components Inspection

1. Inspect condition, mounting, wiring and connections of alternator and regulator.
2. Correct any discrepancies found.

Visual Battery Inspection (Figure 2)

1. Look for any signs of physical damage.
2. Inspect battery posts, cables, and clamps.
3. Note whether the top of the battery is clean and dry.
4. Inspect battery carrier and hold-down for condition and secure mounting of battery.
5. Check electrolyte level.
6. Service as necessary. Replace battery if damaged.

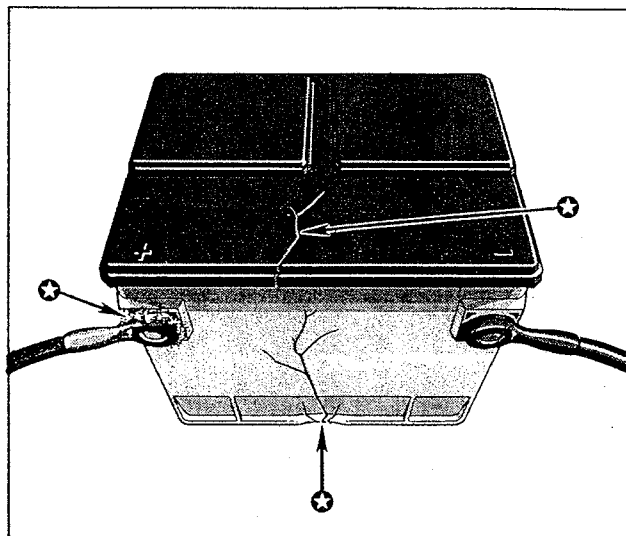


FIGURE 2. Visually inspect battery for damage.

HOOKUPS AND TESTING PROCEDURES

GENERAL TEST CONDITIONS

This condensed testing procedure will detect starting and charging problems, using manufacturer's specifications with the test vehicle at normal operating temperature. Tests can be made under other conditions, but standard specifications will not apply. The general specifications shown here are the 12 volt systems. See manufacturer's specifications for more information.

CALIBRATION AND HOOKUP

All tests (except those requiring the use of the FIELD SELECTOR) can be made without disconnecting any vehicle leads because of the tester's clamp-on AMP PROBE. AMPS DISPLAY readings will be accurate as long as the vehicle battery voltage is 4.5 volts or higher.

- A. Rotate the LOAD CONTROL KNOB fully counter-clockwise to "OFF".
- B. Set FUNCTION SELECTOR to OFF.

WARNING: Sparking may occur if FUNCTION SELECTOR is not in OFF.

- C. Set the VOLT SELECTOR TO "INT."
- D. Connect the tester BATTERY LOAD LEADS to the battery terminals; Red to positive, Black to negative.
- E. Zero displays with ZERO/RESET switch, if needed.

TESTING MODES

Two different testing modes and OFF can be chosen with the FUNCTION SELECTOR to perform a variety of starting, charging, and battery tests.

AUTOMATIC CAPTURE MODE:

Three different types of system tests can be performed in the automatic capture mode.

BATTERY LOAD

The BATTERY LOAD test measures the battery's state-of-charge. The GOOD/BAD indications represent the battery's state-of-charge condition.

By first determining the PRE-TEST condition of the battery and then utilizing a specific time test sequence, a GOOD/BAD determination of the battery state-of-charge can be made.

NOTE: Occasionally battery discharge can be the result of current draw when the vehicle is unattended. This could result from an accessory that has not turned off (trunk light, glove box light, etc.) or a short in a circuit that has power even with the ignition switch OFF.

Determining PRE-TEST condition of battery:

NOTE: Before conducting open circuit voltage test (PRE-TEST) of battery, it is recommended that the surface charge on the battery be reduced by applying at least a 50 amp load to the battery in the MANUAL mode.

1. Be sure LOAD CONTROL KNOB is fully counter-clockwise to OFF and FUNCTION SELECTOR is in the OFF position.
2. Connect BATTERY LOAD LEADS to proper battery terminals. See Figure 3.
3. Set FUNCTION SELECTOR in the BATTERY LOAD position.
4. Observe initial open circuit voltage displays.

If the initial open circuit voltage is equal to or greater than 12.4V in the first 3-second time period:

- GOOD/BAD determination of battery state is made at the end of the actual BATTERY LOAD test sequence based on the **final voltage reading**.

If the initial open circuit voltage is less than 12.4V in this 3-second time span:

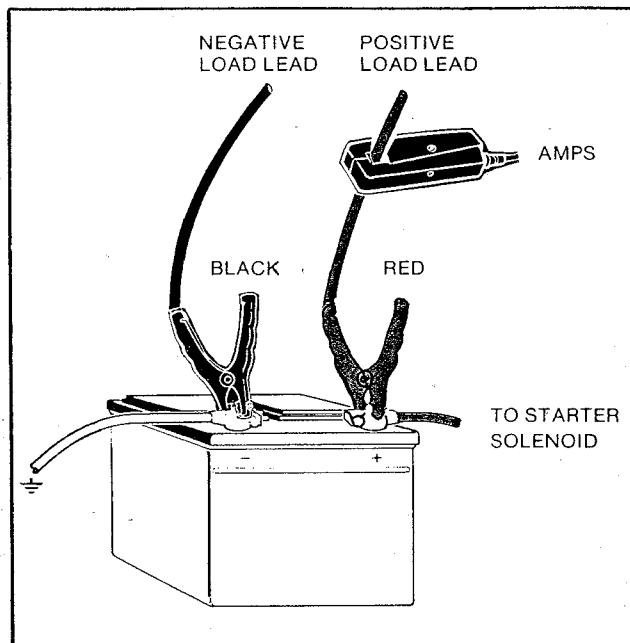


FIGURE 3. Test lead connections for testing battery performance

- AMPS DISPLAY shows "LO."
- BAD condition not indicated at the end of the test sequence even if final voltage value is below 9.6V.
- GOOD condition indicated at the end of the test sequence if the final voltage value is greater than or equal to 9.6V.

NOTE: If the initial open circuit voltage is less than 12.4V ("LO." is indicated), the battery should be charged prior to BATTERY LOAD testing.

BATTERY LOAD TEST

Batteries need to be capable of cranking engines under all load conditions while maintaining enough voltage to supply ignition current for starting.

The generally accepted theory of battery testing is that a battery should maintain a voltage of 9.6 or more under starter load at normal operating temperature. Since starter loads vary and battery sizes vary, the Battery Performance Test is based on battery ratings provided by the manufacturer.

There are now two methods of rating batteries. For years, batteries were rated in "Ampere Hours 20 Hour Rate." A new rating method called "Cold Cranking Current at 0° F" is gradually replacing the Ampere Hour rating. While some battery manufacturer's are supplying both ratings, many are not. Therefore, the method of determining how much

load to apply to test a battery depends on which rating is known.

1. Ampere Hour Rating

If the Ampere Hour rating is known, multiply this rating by 3 to obtain the load. For example, a 60 ampere battery multiplied by 3 equals a 180 ampere load.

2. Cold Cranking Current at 0°F

When using this rating, divide it by 2 to obtain the load. For example, a battery with a Cold Cranking Current rating of 400 divided by 2 equals a 200 amps load.

In the Battery Performance Load Test, the specified load is applied to the battery while observing the battery voltage.

Test sequence

1. Be sure LOAD CONTROL KNOB is fully counterclockwise to OFF and FUNCTION SELECTOR is in OFF position.
2. Connect BATTERY LOAD LEADS to proper battery terminals. See Figure 3 page 5 for hookup.
3. Connect the Black clamp-on AMP PROBE around either **TESTER** load cable (disregard polarity). See Figure 3 for hookup illustration.
4. Set FUNCTION SELECTOR to BATTERY LOAD position.
5. Apply load current of at least 50 amps using LOAD CONTROL KNOB to begin test process and initiate (automatically) 15-SEC. countdown TIMER.
6. Determine PRE-TEST state-of-charge condition of battery by observing initial open circuit voltage reading. Charge battery if open circuit voltage is low. See page 5 for open circuit voltage conditions and good/bad battery determinations.

NOTE: Open circuit voltage should be greater than 12.4V. If not, voltage reading flashes.

7. Load battery to half the manufacturer's-rated cold-cranking amp value for the timed period using LOAD CONTROL KNOB.

8. Maintain load for 15 seconds until beeper sounds and note display readings.

NOTE: Test load amps should be reached as soon as possible after starting to apply load and amps should be maintained by regulating load control.

Test aborted condition

If the amps reading falls below 50 amps before the 15 SEC. TIMER has timed out, the test will be aborted. The values at the last instant the current was still greater than 50 amps will be stored and "FLASH" until the test is reset. The BEEPER will sound twice when the values are stored.

9. After 15-SEC. TIMER has timed out, observe "frozen" voltage and current displays.

Battery state-of-charge indications:

- a. GOOD — maintains a voltage of 9.6 volts or more for at least 15 seconds (5 volts for 6 volt batteries).
- b. BAD — indicates a load voltage of less than 9.6 volts (4.8 for 6 volt batteries). Shows that the battery is **not serviceable in its present condition**. Charge and retest.

NOTE: This battery should also be completely tested to determine if it is defective and needs replacing or is merely in need of a recharge.

A battery reading 9.6 to 9.9 volts (4.8 to 4.9 for 6 volt batteries) would be considered "fair."

NOTE: Batteries that test in this range can be used to perform starting system tests. However, these batteries should be completely tested to determine whether the battery is defective or merely needs charging. Through this process, marginal batteries will be detected and replaced, preventing a road failure.

NOTE: The above conditions also apply to those batteries found to have an initial open circuit voltage of less than 12.4V in the PRE-TEST battery condition evaluation.

STARTING

The first step in testing the Starting System is to make a Battery Performance Test, since a good battery must be used to test the starter motor, cables and solenoid. State of a vehicle battery can be determined in the BATTERY LOAD mode of the tester. With a known good battery, the starter motor, cables, and starter solenoid can be checked by performing the Starting System Test.

The Starting System test should be made with a serviceable battery or the test results could be in error. The engine is cranked with the ignition system disabled so that the engine will not start.

The test procedure consists of cranking the engine for 15 seconds while storing the AMPS DISPLAY values for starter current draw and the tester VOLTS DISPLAY values for cranking voltage.

Good starting systems will read: Starter current not to exceed the **maximum** specified for the vehicle being tested. Cranking voltage on 12 volt systems: some vehicles are rated at 9.6 volts minimum, some at 9.0 volts minimum. On 6 volt systems: 4.8 volts is the minimum. Refer to manufacturer's specifications.

Starting System Area Test

The STARTING SYSTEM test mode displays voltage and current readings and gives a GOOD/BAD indication of starter current draw. In this mode, the VAT 60 stores peak current and the lowest voltage values until the testing is complete and the values can be displayed.

This test should be made only with a serviceable battery. See Figure 4 below for hookup illustration.

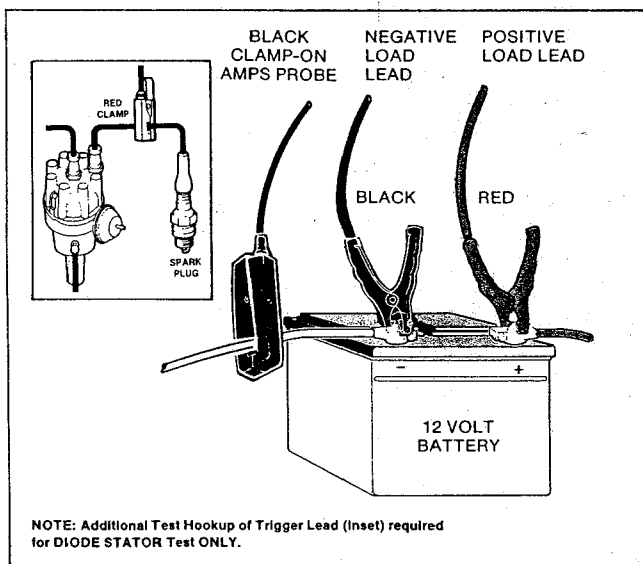


FIGURE 4. Test lead connections for testing the starting system, charging system, voltage regulator, and diode stator.

NOTE: Ignition must be disabled to perform this test and engine must be able to crank for 15 second test duration.

To prevent the engine from starting during the cranking test:

- a. **Gasoline engines with externally mounted ignition coil:** Remove the coil high tension lead at the distributor center tower and connect the disconnected lead to ground.
- b. **Gasoline engines with integral mounted ignition coil:** Disconnect the ignition switch lead from the ignition system assembly (Bat +). Do not allow lead to touch ground.

Test sequence

1. Turn off all lights and accessories and close all doors.
2. Be sure LOAD CONTROL KNOB is fully counter-clockwise to OFF and FUNCTION SELECTOR is in OFF position.
3. Connect leads to proper battery terminals and AMP PROBE to proper lead. See Figure 4.
4. Connect the Black clamp-on AMP PROBE around the **vehicle** ground battery cables. If more than one cable is connected to battery post, place clamp around all cables. Arrow should be pointing away from battery terminal.
5. Set the FUNCTION SELECTOR in the STARTING position.
6. Observe initial open circuit voltage.

If the initial open circuit voltage is less than 12.4V:

BAD — **not** displayed if the final voltage value is less than 9.6V.

GOOD — displayed if the final voltage value is 9.6V or greater.

7. Crank engine and attain starter current greater than 50 amps to begin test sequence and initiate 15-SEC. countdown TIMER.

Beginning three seconds into the 15-second time period, the VAT 60 proceeds to store the peak amp and lowest voltage values until the test time expires.

Voltage value

If the voltage value falls below 9.6V after three seconds into the test sequence or anytime before the 15-second test sequence begins, testing should continue despite a BAD display reading.

Peak running current

If the starter current drops below 50 amps after the test has begun, the test will be aborted. the BEEPER will sound twice at the end of the test but no GOOD-/BAD indication will be made.

8. Crank engine 15 seconds and observe results.

Starting system test indications:

- a. AMPS DISPLAY reading should not exceed maximum specified by manufacturer.
- b. Voltage should be at or above minimum specified.
- c. Cranking speed should be normal.

NOTE: If no specification is available, a rule of thumb is:

Starter Current Draw — OK Readings		
8 cylinder	6 cylinder	2 — 5 cylinder
under 280 amps	under 240 amps	under 210 amps

Cranking voltage —

9.6 volts or higher — OK.

Experience and tests of good starting systems will provide the best test data when no specification is available.

Test indications

GOOD — final voltage value 9.6V or greater; final voltage value and peak current displayed.

BAD — final voltage value less than 9.6V; lowest starter voltage value stored and peak current displayed.

Perform the voltage drop tests of cables and solenoid presented in the STARTING SYSTEM PINPOINT TESTING section (page 10 to determine whether trouble is in the

starter, cables, or solenoid.

9. Restore engine to starting condition.

CHARGING/DIODE STATOR

The main function of the charging system is to produce all of the electrical power required by the vehicle electrical system. While the engine is being operated at a reasonable speed above idle, the output of the charging system is used directly to operate the ignition system, lights, radio, and all other electrical accessories. In addition, under these operating conditions, the charging system output must be sufficient to maintain the battery in a full state of charge.

In the design of the vehicle, each manufacturer determines the total electrical requirements of the vehicle and then selects a generator or alternator of sufficient capacity to handle the load. The vehicle's axle ratio is also taken into consideration when determining the charging unit drive belt ratio. Thus, the specified charging system output and the test speed may vary somewhat from one make of vehicle to another.

Another important consideration in charging system operation is the level at which the charging system voltage is limited. If the voltage is limited at too low a level, it is impossible to maintain the vehicle's battery at a full state of charge. On the other hand, if too high a limit is selected, battery overcharge, excessive light flare, and short electrical accessory life will result.

As charging system outputs vary from make to make, the voltage limiter (regulator) specifications can also vary. Each manufacturer will specify a voltage limiter operating range best suited for each specific vehicle. Voltage limiter operating specifications may vary depending upon circuit length and design and specified operating temperature. For example, 1975 passenger cars call for settings as low as 13.4 to 14.4 volts on some GM products and as high as 14.3 to 15.8 on the Dodge Colt.

Always compare test results with manufacturer's specifications before coming to conclusions regarding the performance or efficiency of charging systems and their components.

ALTERNATOR TESTING

A characteristic of alternator type charging systems is that occasionally one will test almost to specification even though the unit contains an "open" diode.

The importance of detecting an "open" diode is that, in addition to the loss of several amperes of output, an open diode can lead to the failure of other diodes, resulting eventually in a dead battery. In addition, an open diode could cause a voltage regulator to fail. A replacement regulator would also fail if the open diode was not detected and corrected. To avoid the possibility of overlooking this type of defect, the VAT 60 includes a DIODE STATOR testing mode.

The VAT 60 is programmed to make the necessary tests of a charging system. Since the battery is a part of the charging system, its condition must be considered when testing the alternator and voltage regulator. The condition of the battery determines how hard the alternator works and a bad battery can cause an alternator failure.

In addition, the condition of the starting system, or of the engine if it is hard to start, can cause a battery to be run down. Therefore, any test of the charging system should include a test of the battery and starting system.

CHARGING SYSTEM TEST

See Figure 4 (page 7) for hookup illustration.

1. Attach the Black clamp-on AMP PROBE around **vehicle ground** cable or cables. Be sure arrow is pointing away from battery terminal.
2. Set the FUNCTION SELECTOR to the CHARGING/DIODE STATOR position.
3. Observe tachometer and bring engine speed to 2500 rpm.
4. Adjust the LOAD CONTROL KNOB slowly as required to obtain the highest reading on the AMPS DISPLAY. **Perform this test within 15 seconds.**
5. Rotate the LOAD CONTROL KNOB to OFF.
6. Continue holding engine speed over 2000 rpm to allow accurate voltage regulator reading. This occurs when alternator output drops below 15 amps. This could take several minutes.

7. Observe results.

GOOD — Alternator/Generator output within 10% of manufacturer's specification.

BAD — Output not within 10% of specifications. Perform OUTPUT TEST USING TESTER FIELD SELECTOR.

CHARGING/DIODE STATOR TESTS

The CHARGING/DIODE STATOR test position actually performs three tests:

1. Diode Stator test
2. Maximum Alternator Output test
3. Voltage Regulator upper limit cutoff voltage indication.

Test sequence

1. Be sure LOAD CONTROL KNOB is fully counterclockwise to OFF and FUNCTION SELECTOR is in OFF position.
2. Connect leads to proper battery terminals and AMP PROBE to proper lead. See Figure 4 page 7 for hookup illustration. Be sure to connect trigger lead as designated in Figure 4.
3. Set FUNCTION SELECTOR to CHARGING/DIODE STATOR position.
4. Turn headlights, blower, and other accessories ON for 10 amp load minimum.
5. Achieve engine speed of 2500 rpm to begin testing.
6. Observe DIODE STATOR determination 3 seconds into test (DIODE STATOR test).

Test conditions

Current is at least 10 amps and rpm is 2500 or more.

7. **After DIODE STATOR determination**, begin loading the alternator until a peak amp reading is obtained (Maximum Alternator Output test).

NOTE: Operator has 15 seconds to load alternator for peak amp reading after DIODE STATOR determination is displayed.

8. Turn off load. Observe displays until test time expires.

Testing automatically continues until:

- a. current reading is less than 15 amps and/or
- b. voltage is greater than 15.8v at an engine speed of 2000 rpm or more.
- c. testing aborts.

Test abort conditions

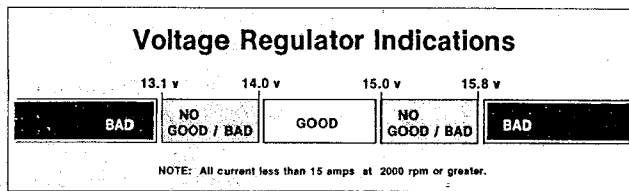
- a. engine speed falls below 2000 rpm.
 - b. current reading is less than 5 amps.
9. Observe final test results. Highest voltage value and peak amp reading displayed (Voltage Regulator test).

Test indications:

GOOD — voltage value more than 14.0V; current less than 15 amps at 2000 rpm or greater.

NO GOOD/BAD — voltage values 13.1 to 14.0 and 15.0 to 15.8V.

BAD — voltage value less than 13.1V, greater than 15.8V; current less than 15 amps at 2000 rpm.



MANUAL

The MANUAL testing mode allows the operator to read volts (internal and external), current, and rpm and reset test values.

GENERAL TEST CAPABILITIES

General testing (Battery Load, Alternator Output, Voltage Regulator, and Starter Draw) can be performed by the operator in the MANUAL mode, excluding Diode Stator tests. Also, no GOOD/BAD indication or data capture feature is available in the MANUAL mode.

Load measurement capability can also be utilized in the MANUAL mode. A 15 SEC. TIMER is activated in this mode whenever the operator applies a load of 50 amps or more to the battery with the LOAD CONTROL KNOB. Once the TIMER has timed out, no GOOD/BAD determination is made. No beep will sound indicating the end of the TIMER countdown.

The TIMER can be reset by the operator by reducing the load to below 50 amps and then increasing the load to 50 or greater again.

All through the load-applying process the LOAD LIGHT will indicate when load is being applied. A thermo sensor/switch will be utilized to activate alarm if load being applied causes the carbon pile assembly to overheat.

Pinpoint tests can also be performed in the MANUAL mode. See PINPOINT TESTING.

NOTE: If present, rpm value will be displayed at all times in the MANUAL mode.

PINPOINT TESTING

STARTING SYSTEM PINPOINT TESTS

Vehicles failing the Starting System Area Test need a pinpoint test of the cables and starter solenoid to determine whether the problem is in the cables, the solenoid, or the starter.

INSULATED CIRCUIT RESISTANCE TEST

Excessive resistance in the starting system circuitry (wiring or frame connections) can cause slow cranking speed and hard starting.

The starting system's main electrical circuit is generally a series circuit from the battery insulated post to a starter solenoid, to the starter motor, to ground (chassis), and then returning to the battery ground post. The solenoid is controlled or operated by the ignition switch. This solenoid circuit frequently contains a safety switch such as the transmission "Neutral switch" or "Clutch switch."

The starting system will function properly only when these circuits and electrical components are in satisfactory condition. Corrosion, loose terminals, damaged or undersized cables will cause cranking problems. In addition, the switches involved must make good electrical connections when closed.

Test Procedure

Voltage drops are measured by connecting a voltmeter in parallel (across) the circuit section under test and then reading the VOLTS DISPLAY while the circuit under test is in operation. Test is of voltage drop from battery to starter (insulated circuit).

NOTE: BATTERY LOAD LEADS must be connected to battery for tester power.

Testing can be done with FUNCTION SELECTOR in MANUAL position.

- A. Set the VOLT SELECTOR to EXT.
- B. Connect test leads as shown in Figures 5 and 6 for type of circuit being tested.
- C. Disconnect lead from coil secondary (tower) to prevent engine from starting during test.
- D. Crank engine and observe VOLTS DISPLAY reading while cranking. Reading should be within manufacturer's specifications.

Test indications:

GOOD — Less than 0.4 volt (6 volt system)
 Less than 0.5 volt (12 volt system)
 go to Ground Circuit Resistance Test.

BAD — More than 0.4 volt (6 volt system)
 More than 0.5 volt (12 volt system)

NOTE: To locate the cause of the excess voltage drop, move the EXT VOLT LEAD on the starter progressively toward the battery. With each move, crank engine and read voltage. When a noticeable decrease in the voltage reading is observed, the trouble is located between that point and the preceding point tested. It will be either a damaged cable or poor connection, an undersized wire, or possibly a bad contact assembly within the solenoid.

Values of maximum voltage drops for the cranking circuit are as follows:

Each cable — 0.1 volt (6 volt) 0.2 volt (12 volt).

Each connection — 0.0 volts both 6 and 12 volt systems.

Starter Solenoid Switch — 0.3 volts both 6 and 12 volt systems.

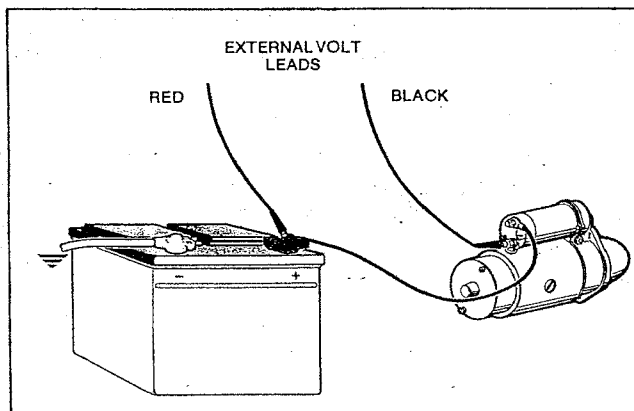


FIGURE 5. External volt lead connections where starter solenoid is on the starter.

GROUND CIRCUIT RESISTANCE TEST

Connect volts leads across the ground circuit as follows and read voltage drop while cranking engine.

NOTE: BATTERY LOAD LEADS must be connected to battery for tester power.

Testing can be done with FUNCTION SELECTOR in MANUAL position.

- A. Set VOLT SELECTOR to EXT.
- B. Observing polarity, connect volt leads to battery ground post and starter motor case (Figure 7). Scratch through paint with clip for good connection.

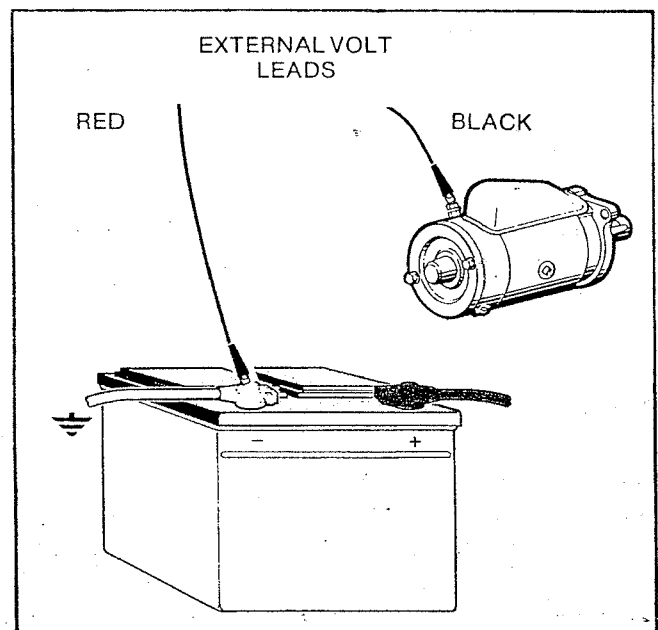


FIGURE 7. External volt lead connections for starting ground circuit resistance test.

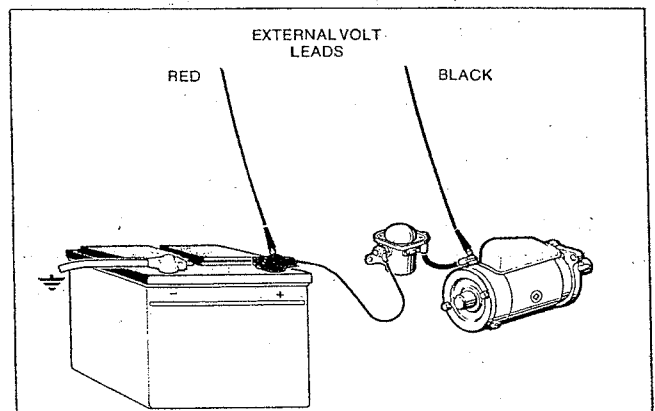


FIGURE 6. External volt lead connections where starter solenoid is between battery and starter.

C. Crank engine and observe VOLTS DISPLAY reading while cranking. Reading should be within manufacturer's specifications.

Test indications:

GOOD — Less than 0.1 volt (6 volt system)
Less than 0.2 volt (12 volt system)
go to Insulated Circuit Resistance Test.

BAD — More than 0.1 volt (6 volt system)
More than 0.2 volt (12 volt system)
indicates the presence of a poor ground circuit connection. Could be a loose starter motor mounting bolt or a bad battery ground terminal post connector, or a damaged or undersized ground system wire from battery to engine block.

Isolate the cause of excess voltage drop in the same manner recommended in the Starter System Insulated Circuit Test.

SWITCH CIRCUIT RESISTANCE TEST

High resistance in the solenoid switch circuit will reduce the current flow through the solenoid windings which can cause improper functioning of the solenoid. In some cases of high resistance, it may not function at all. Improper functioning of the solenoid switch will generally result in burning of the solenoid switch contacts causing a high resistance in the starter motor circuit.

Test Procedure

Check vehicle wiring diagram, if possible, to identify the solenoid circuit components. These are usually the ignition switch, the automatic transmission neutral switch, and the starter solenoid winding. In some instances, a separate starter relay is also used, and the contacts in this starter relay should be checked for excessive resistance just as the solenoid switch is tested.

NOTE: BATTERY LOAD LEADS must be connected to battery for tester power.

Testing can be done with FUNCTION SELECTOR in MANUAL position.

- Set the VOLT SELECTOR to EXT.
- Observing polarity, connect volt leads to both solenoid switch terminals as shown in Figure 8.
- Automatic transmission vehicles — place transmission lever in neutral or park.
- Crank engine using the vehicle's ignition switch. Observe VOLTS DISPLAY.

Test indications:
(Unless otherwise specified)

GOOD — Less than 0.5 volt — indicates circuit condition good. If starter current draw was high or cranking speed slow, a faulty starter motor is indicated. In this case, the motor should be removed for replacement or repair.

BAD — More than 0.5 volt — indicates excessive resistance. If VOLTS DISPLAY reads more than 0.5 volts, it is usually an indication of excessive resistance. However, on certain vehicles, experience may show that slightly more voltage loss is normal.

Isolate the point of high resistance by placing the volt leads across each compartment of the circuit in turn, taking readings with the starter motor control switch operated. A reading of more than 0.1 volt across any one wire or switch is usually an indication of trouble.

NOTE: Neutral Safety Switch should be checked for voltage drop.

If high readings are obtained across the neutral safety switch used with automatic transmissions, check the adjustment of the switch as outlined in the manufacturer's shop manual.

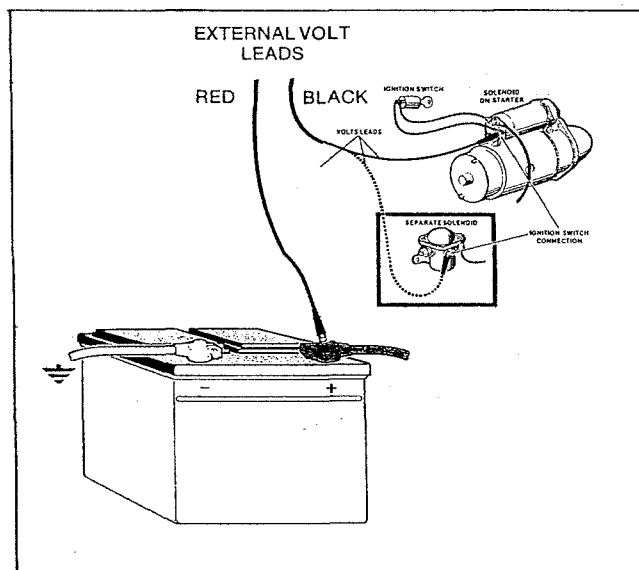


FIGURE 8. External volt lead connections for starting solenoid switch circuit resistance test.

CHARGING SYSTEM PINPOINT TESTS

This section presents a systematic method of testing the charging system. It presents the detailed tests that would be used to locate the source of any failures that may be found during area testing.

OUTPUT TEST USING TESTER FIELD SELECTOR

NOTE: This test is to determine if alternator or voltage regulator is bad. The test is for alternator charging systems only. Refer to the instructions of DC charging systems.

- A. Stop engine and **disconnect the vehicle lead from the alternator field terminal** or disconnect the regulator connector plug if field terminal is inaccessible). See Figure 9.
- B. Select proper lead terminal and connect the **BLUE tester FIELD LEAD** to the alternator field terminal (or to the field lead in the regulator connector plug).

CAUTION: Never use **BLUE FIELD LEAD** with voltage regulator connected.

NOTE: Refer to "Special Alternator Test Information" card Sun #692-855 for identifying field terminal, and for instructions on bypassing regulators on Delcotron alternators with internal voltage regulators.

- C. Set the **FUNCTION SELECTOR** to the **CHARGING/DIODE STATOR** position.
- D. Start engine and adjust speed to 2500 rpm's.
- E. Rotate the **LOAD CONTROL KNOB** clockwise for the duration of the 15 second timer.

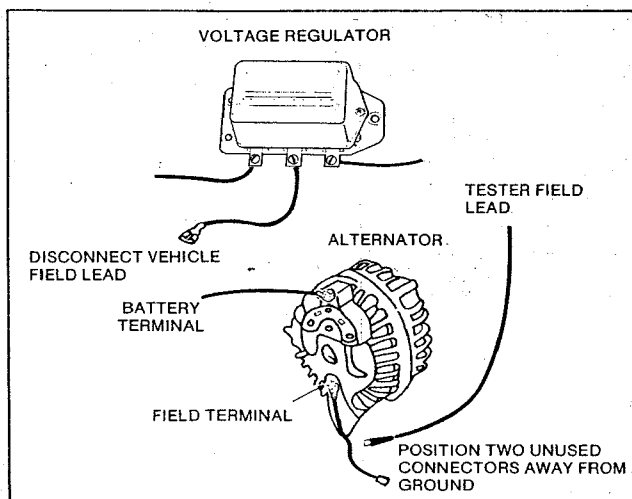


FIGURE 9. Field lead connections for testing the alternator.

- F. Hold the **FIELD SELECTOR** rocker switch in position A or B as indicated on the "Special Alternator Test Information" reference card.

NOTE: Positions reverse on positive ground systems. "A" becomes "B" and "B" becomes "A". However, no damage will occur if the wrong position is used. If it is unknown which system applies, test in each position.

- G. Release the **FIELD SELECTOR**, turn **LOAD CONTROL KNOB** off and complete rest of test.

CHARGING SYSTEM REQUIREMENTS TEST

As indicated earlier, the charging system output should be great enough to satisfy all the electrical requirements of the vehicle and should include enough output to assure that the battery will be maintained in a state of full charge.

Occasionally you will encounter a vehicle in which electrical accessories have been added. Sometimes you will not be able to determine the rated output of the vehicle's alternator. To determine whether this charging system output is still adequate to meet the requirements of the vehicle perform **CHARGING SYSTEM REQUIREMENTS TEST**.

- A. With engine stopped and **FUNCTION SELECTOR** in the **CHARGING/DIODE STATOR** position (Figure 4), turn on all vehicle accessories, ignition switch, headlights at high beam, air conditioning, windshield wipers, rear window defroster if so equipped, etc.
- B. Note reading on **AMPS DISPLAY**. This reading is the total accessory load. Compare this reading to the total alternator output reading obtained in **CHARGING SYSTEM TEST**. Total alternator output reading should exceed accessory load reading by 5 amps or more.

DC CHARGING SYSTEM (GENERATORS) TEST

DC charging systems are tested the same as AC charging systems, but the test indications are different. See Figure 10 for hookup.

GOOD — Output equals or exceeds manufacturer's specifications. If vehicle wiring is good, the voltage regulator is bad.

BAD — Output does not reach manufacturer's specification or excessive arcing is noted at the commutator. Generator is **BAD**. If amperage is low and voltage is high, the cutout relay fails to close, or the regulator has poor ground.

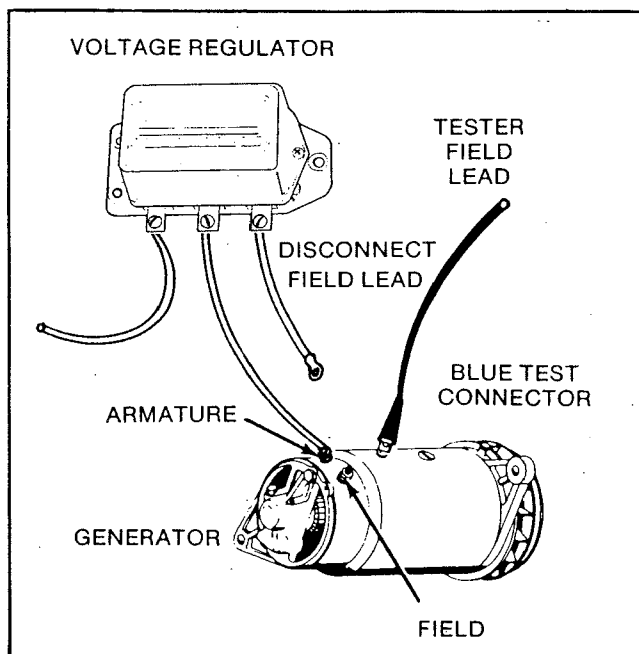


FIGURE 10. Field lead connections for testing the DC generator.

CIRCUIT RESISTANCE TEST

Circuit resistance tests are made to determine the amount of voltage loss occurring between the output terminal of the generator or alternator and the insulated battery post, and between the generator or alternator housing and the ground battery post respectively. Any voltage loss caused by high resistance in these circuits will reduce the overall charge rate and lead to eventual battery discharge.

Test Procedure

- A. Set FUNCTION SELECTOR to MANUAL mode.
- B. Set LOAD CONTROL KNOB to the OFF position.

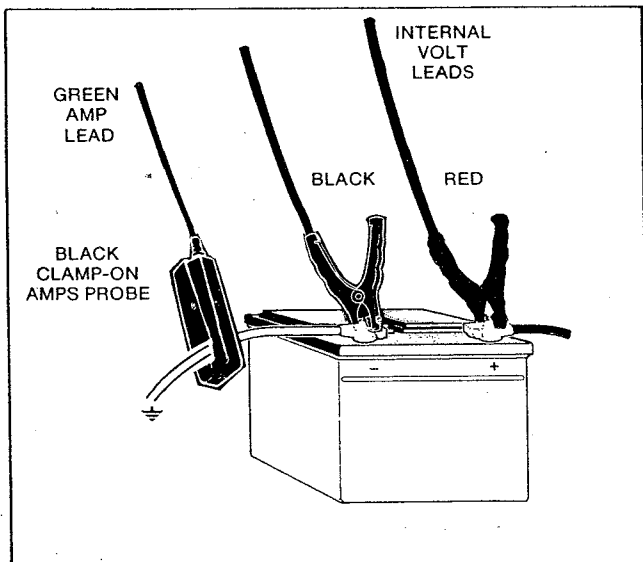


FIGURE 11. Ammeter and internal lead connections used during charging system testing.

- C. Set VOLT SELECTOR to EXT.
- D. Connect tester leads as shown in Figures 11 and 12. Reverse volt leads when testing vehicles with positive ground electrical systems.
- E. Start engine and adjust speed to approximately 2000 rpm.
- F. Adjust LOAD CONTROL KNOB until the reading of the AMPS DISPLAY indicates the test current specified by the manufacturer.
- G. Observe the reading on the VOLTS DISPLAY.
- H. Set VOLT SELECTOR to INT. Observe the reading on the VOLTS DISPLAY. Subtract this reading from the reading obtained in Step G. This difference is the voltage drop caused by circuit resistance and must be within specifications for proper charging system operation.

Test indications:

GOOD — Voltage difference within specifications — indicates charging circuit good — perform Regulator Ground Circuit Resistance Test.

BAD — Exceeds specifications — conduct Charging System Insulated Circuit Resistance Test.

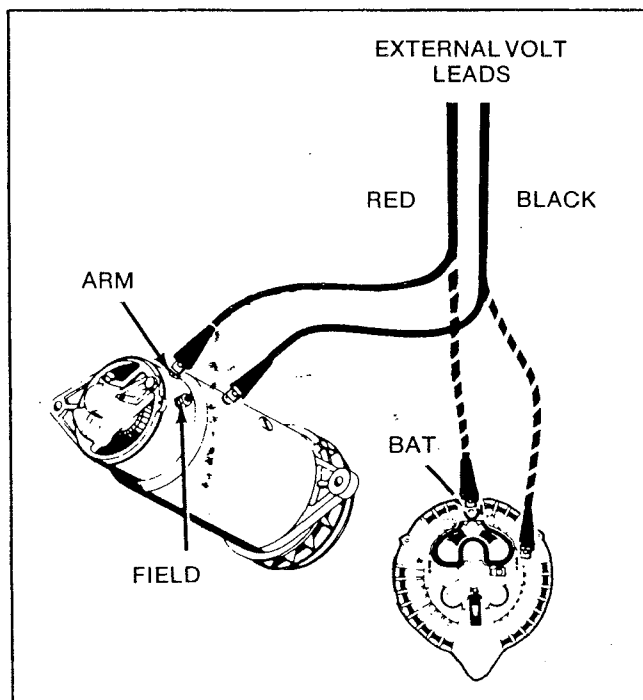


FIGURE 12. External volt lead connections for charging circuit resistance test.

NOTE: The circuit resistance, as indicated by the above VOLTS DISPLAY reading, is equal to the total of both the Insulated Circuit and the Ground Circuit Voltage losses.

In general, on alternator systems, the following specifications apply:

American Motors	0.65 volt MAX
Chrysler Motors	0.9 volt
Ford Motor Company	0.4 volt w/Ind Lamp 0.8 volt w/Ammeter
General Motors	0.65 volts

INSULATED CIRCUIT RESISTANCE TEST

If voltage loss in the preceding test (System Circuit Resistance) exceeds the specified amount, an excessive resistance is present within the charging circuit. That is, within the wiring harness, connections, regulator and vehicle ammeter if used. The excessive resistance can take the form of LOOSE OR CORRODED CONNECTIONS at output terminal of generator or alternator, armature terminal of regulator, back of ammeter or battery terminal of the starter solenoid battery cable connections, faulty wiring from generator to regulator to ammeter or ammeter to starter solenoid, burned or oxidized cutout relay contacts, or poor electrical connections between the generator or alternator and the engine. To isolate the point of excessive resistance, proceed with the following charging system resistance test.

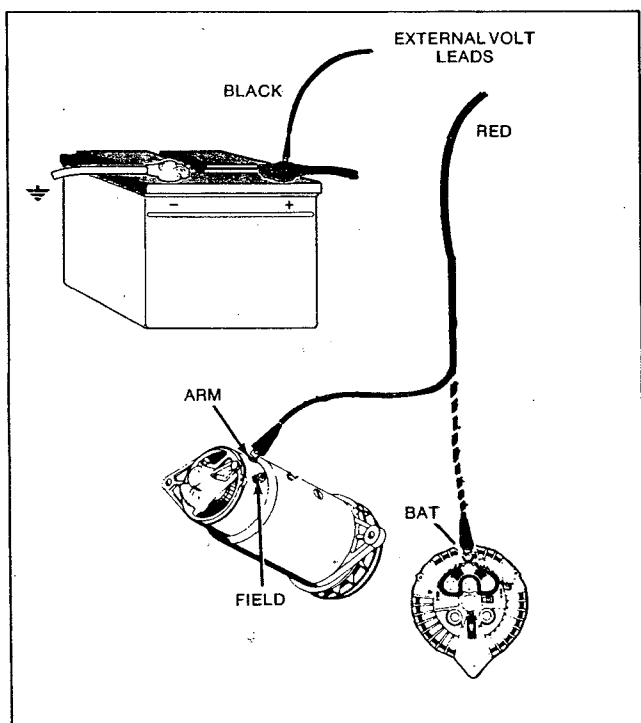


FIGURE 13. External volt lead connections for charging insulated circuit resistance test.

Test Procedure

- Set FUNCTION SELECTOR to MANUAL mode.
- Set VOLT SELECTOR to EXT.
- Observing polarity, connect test leads as shown in Figures 11 and 13. Reverse volt leads for positive ground systems.
- Start engine and adjust speed to approximately 2500 rpm.
- Adjust LOAD CONTROL KNOB until AMPS DISPLAY indicates the test current specified by the manufacturer.
- Observe voltage reading on VOLTS DISPLAY and compare with specifications.

Test indications:

Volts Display Reading:

GOOD — Within specifications — proceed to Ground Circuit Resistance Test.

BAD — Above specifications — indicates excessive circuit resistance. Repeat this test with volt leads connected across each connection and each wire of insulated circuit. Compare reading with maximum connector and wire specifications to isolate the point of high resistance.

GROUND CIRCUIT RESISTANCE TEST

- Set FUNCTION SELECTOR to MANUAL mode.
- Observing polarity, connect test leads as shown in Figures 11 and 14. Reverse volt leads for positive ground systems.
- Start engine and adjust speed to 2500 rpm.
- Adjust LOAD CONTROL KNOB until AMPS DISPLAY indicates the test current specified by the manufacturer.
- Observe VOLTS DISPLAY and compare results with specifications.

Test indications:

GOOD — Within specifications — proceed to Regulator Ground Circuit Resistance Test.

BAD — Above specifications — repeat test with volt leads connected across each connection and each wire of the ground circuit to isolate point of resistance.

REGULATOR GROUND CIRCUIT RESISTANCE TEST

- A. Set FUNCTION SELECTOR to MANUAL mode.
- B. Set VOLT SELECTOR to EXT.
- C. Observing polarity, connect test leads as shown in Figures 11 and 15. Reverse volt leads for positive ground systems.
- D. Start engine and adjust speed to approximately 2500 rpm.
- E. Adjust LOAD CONTROL KNOB until AMPS DISPLAY indicates the test current specified by the manufacturer.
- F. Observe the reading on the VOLTS DISPLAY and compare results with specifications.

Test indications:

GOOD — Within specifications — circuit good.

BAD — Above specifications — if VOLTS DISPLAY reading exceeds 0.1 volt, excessive resistance is present in the ground circuit between the regulator and generator or alternator. Check regulator ground system for loose mounting bolts or damaged group strap.

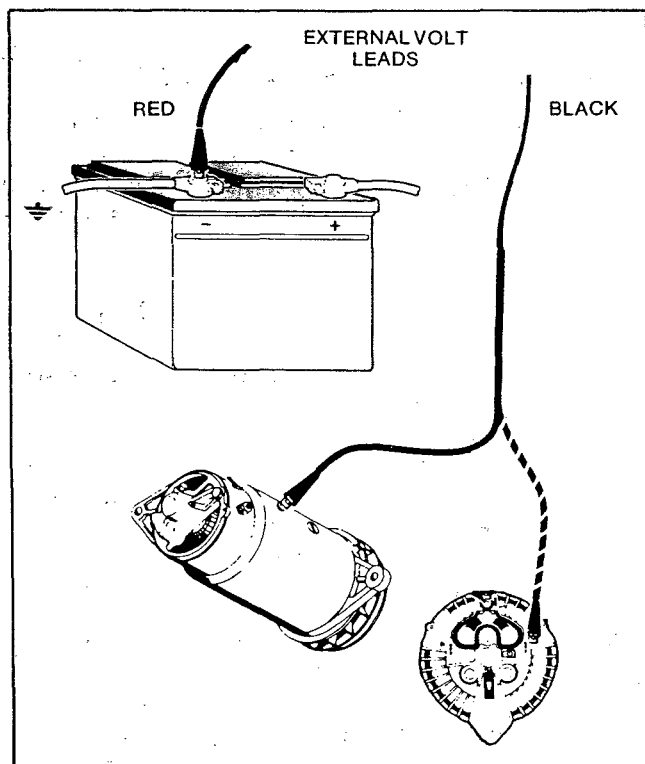


FIGURE 14. External volt lead connections for charging ground circuit resistance test.

12 VOLT CHARGING — 24 VOLT STARTING TESTING PROCEDURES

PREPARATION AND HOOKUP

- A. Turn FUNCTION SELECTOR off and LOAD CONTROL KNOB fully counterclockwise (off).
- B. Observe polarity, connect the **Internal LOAD LEADS** to the (A) battery (+) positive and negative (-) post cables as illustrated in Figure 16.

NOTE: Tester load light should be off, indicating no load.

- C. Set the VOLT SELECTOR to the EXT position.
- D. Connect the EXT volts; red positive lead to the system (B) battery positive (+) post cable; Black negative lead to the (A) battery negative (-) post cable, as illustrated in Figure 16.
- E. Connect the black AMP PROBE around the tester positive (+) load cable with the clamp arrow pointing to the tester.
- F. Rotate LOAD CONTROL KNOB as required to obtain an amps display reading of approximately 200 amperes. (LOAD INDICATOR should be on.)
- G. Rotate the LOAD CONTROL KNOB fully counterclockwise to "off" position. (LOAD INDICATOR should be off.)

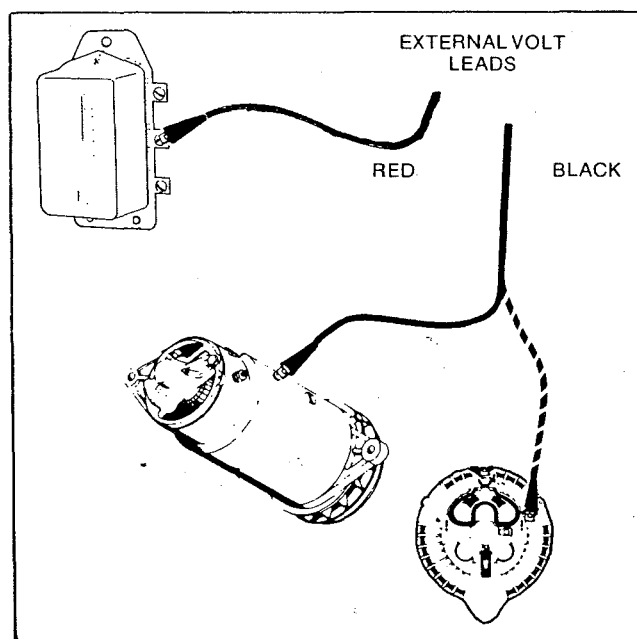


FIGURE 15. External volt lead connections for charging regulator ground circuit resistance test.

H. Disconnect the black AMP PROBE.

Engine Preparation for Starter System Testing

A. Gasoline engines with externally mounted ignition coil.

— Remove the coil high tension lead at the distributor coil tower and connect the disconnected lead to an engine ground.

B. Gasoline engines with integral mounted ignition coil.

— Disconnect the ignition switch voltage supply lead at the distributor ignition unit battery terminal.

C. Gasoline engine with magneto ignition.

— Connect a jumper lead to the magneto grounding terminal and to an engine ground.

D. Diesel engines.

— Move the control lever to the fuel OFF position, or disconnect the fuel solenoid voltage supply lead.

STARTER SYSTEM TESTS

A. Make sure all lights and accessories are off and doors closed.

B. Set the FUNCTION SELECTOR to the STARTING position.

C. Adjust AMPS DISPLAY and black AMP PROBE to read ZERO using the ZERO/RESET switch.

D. Connect the black AMP PROBE around the vehicle (A) battery negative (-) post cable, with the clamp arrow pointing **toward** the battery.

E. Crank the engine for the 15 second time period.

F. Set FUNCTION SELECTOR and LOAD CONTROL KNOB fully to OFF position.

G. Disconnect leads.

CHARGING SYSTEM TESTS

A. Prepare tester/hookup as outlined in A and B in HOOKUPS AND TESTING PROCEDURES.

B. Set the VOLT SELECTOR to INT for 12 volt system.

C. Adjust AMPS DISPLAY and black AMP PROBE to read ZERO using the ZERO/RESET switch.

D. Perform DIODE STATOR test.

1. FUNCTION SELECTOR in CHARGING/DIODE STATOR position.

2. Achieve engine speed of 2500 rpm or greater.

3. Observe DIODE STATOR determination displayed after 3 seconds if current is at least 5 amps.

E. Set FUNCTION SELECTOR to OFF position.

F. Disconnect leads.

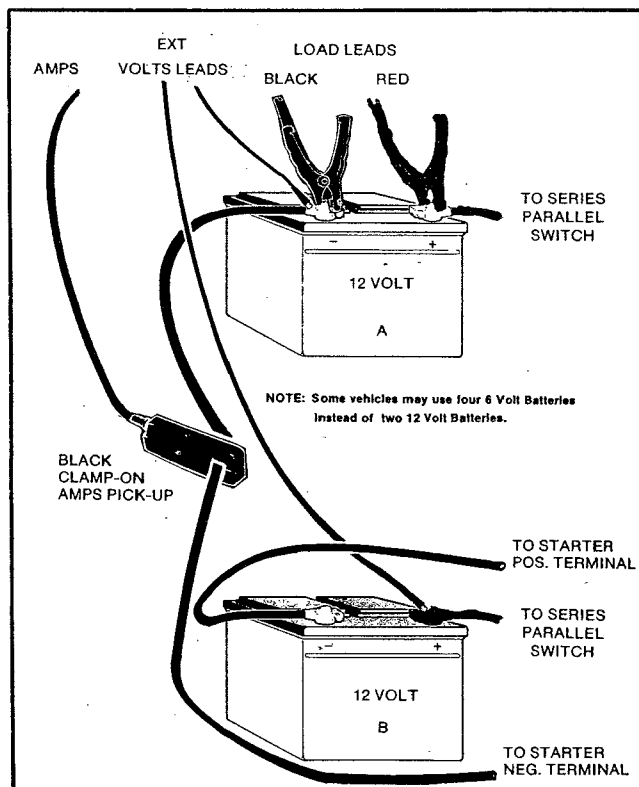
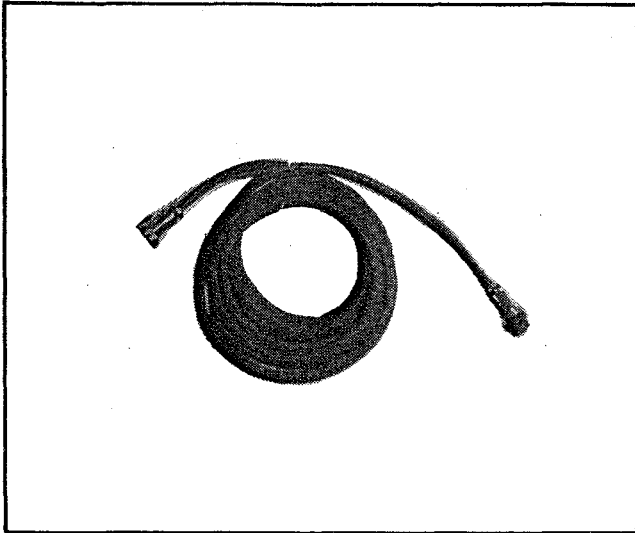
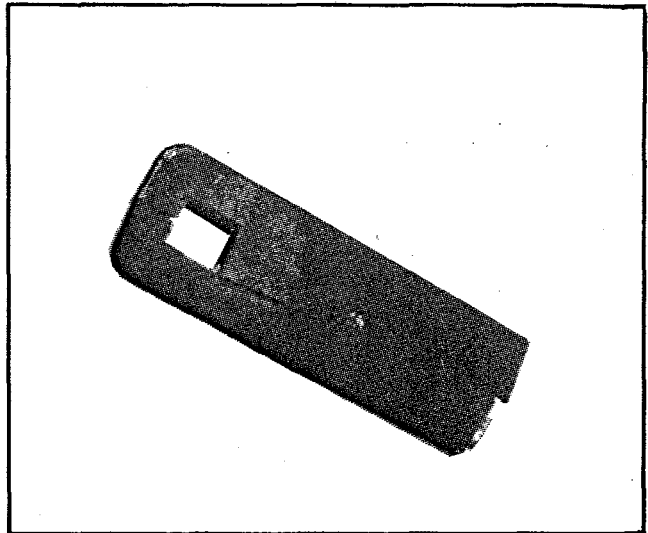


FIGURE 16. 12-24 Volt Series-Parallel starting circuit test connections (Negative Ground shown).

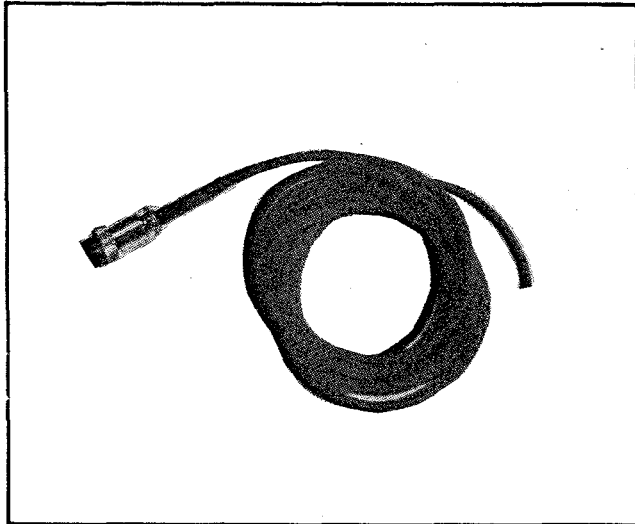
COMPONENTS AND ACCESSORIES



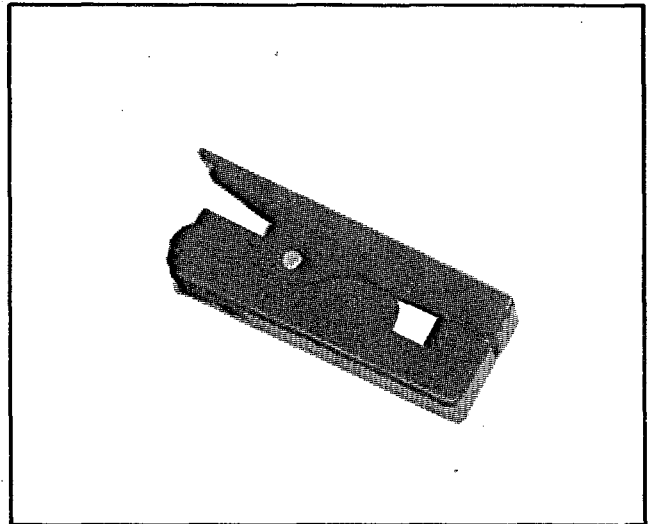
6004A-9300-07 Green Amp Lead



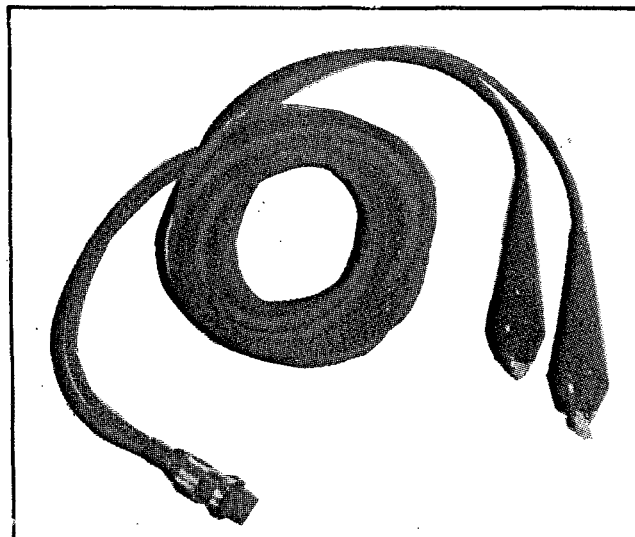
6004A-9300-05 Black Amp Clamp



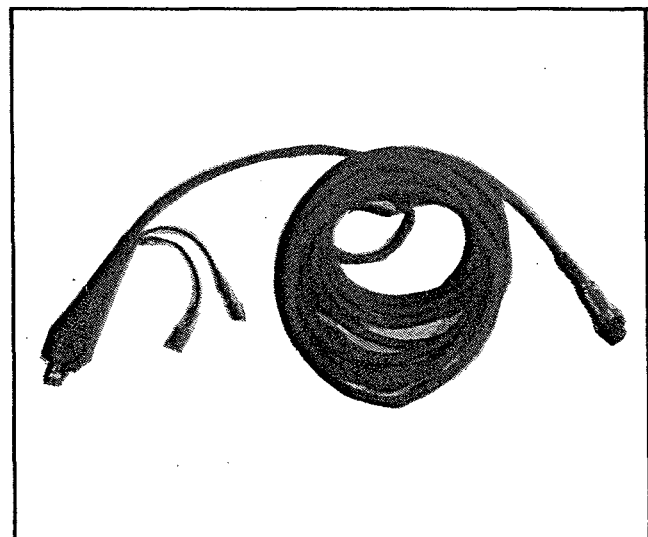
6004A-9300-03 Red Trigger Lead



0507-0006 Trigger Clamp



6004A-9300-04 External Volt Leads



6004A-9300-06 Blue Field Leads